

REMARKS

Reconsideration of the present patent application is respectfully requested. Claims 1-39 are pending in this application. By this amendment, claims 21, 23, 30 and 34 have been amended, claim 33 has been cancelled, and claim 40 has been added as a new claims.

The Claims:**Claim 1:**

Claims 1-7, 13 and 25-29 have been rejected under 35 USC § 103(a) as being unpatentable over Orban (United States Patent No. 5,168,526) in view of Toumazou et al. (Electronic Letters, No. 22, Oct. 1994, pgs. 1839-1841). Claim 1, recites an analogue signal processor comprising:

"an audio input signal, an output for providing a processed audio output signal, and a tone control circuit coupling the input and the output and comprising first and second log-domain filters having different low-pass bands and a subtractor for subtracting the output currents of the filters to produce a filtered signal, each of the filters comprising MOS transistors operating in weak inversion."
(emphasis added).

The Office Action states that Orban discloses an analog audio signal processor (Figure 1), comprising an input for receiving an audio input signal (10), and output for providing a processed audio output signal (190), and a tone control circuit coupling the input to the output and comprising first and second filters having different low-pass bands (70 and 80) and a subtractor for subtracting the output currents of the filters to produce a filtered signal (180). Orban does not disclose the filters being log-domain or comprising of MOS transistors operating in weak inversion. The Office Action further states that Toumazou discloses a signal processing circuit (Figure 2) of a log-domain filter employing MOS transistors operating in weak inversion (Column 2, paragraph 2). According to the Office Action, Toumazou teaches the class of filter having a very high dynamic range, good linearity, and high frequency performance. Based on these statements, the Office Action concludes that it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the use of log-domain filters and MOS transistors with the signal processor to produce a higher dynamic range taught by Toumazou. For the following reasons, Applicants respectfully disagree.

Orban describes a circuit for providing audio peak limiting which obviates the problem of canceling clipping-induced distortion. Contrary to the Examiner's assertion, the circuit of Orban is not designed to provide tone control. The cut-off frequencies of the two low-pass filters (70) and (80) are fixed at 15kHz and 2.2kHz as set forth in the second paragraph of column 3 of the '526 Patent, as well as

in claim 5. These values are determined by the function which the circuit is designed to perform and are not variable, i.e. they do not allow the tone of the input audio signal to be controlled. Toumazou does not remedy this deficiency.

The Examiner argues that it would have been obvious to one of ordinary skill in the art to combine the use of log-domain filters and MOS transistors as taught by Toumazou with the audio signal processor of Orban. However, as the processor of Orban is designed to provide a very specific function, i.e. that of canceling distortion due to clipping, the low-pass filters of Orban's processor *must* have very specific properties. There is no reason or motivation for a skilled person to introduce the particular log-domain filters taught by Toumazou into the processor of Orban. Indeed, one can only assume that this would have caused a deterioration in the performance of Orban's processor or would have entirely prevented it from performing the function for which it is designed. Incorporating filters of the type described in Toumazou into the processor of Orban would also not have achieved a processor providing the functionality which the circuits described in Toumazou are designed to achieve. Toumazou aims to provide a circuit for providing a plurality of stimulating voltages at respective locations of a damaged cochlea. In particular, Figure 3 of Toumazou shows a cascaded low-pass filter which provides a number of outputs (out 1 to out 4). As already noted, Orban provides for distortion correction.

Taking the reverse approach, i.e. replacing each of the "biquad" blocks of the Toumazou filter with the signal processors of Orban (e.g. as illustrated in Figure 1 of Orban) would result in an arrangement which would not function at all, as each biquad section would then comprise a band-pass filter. The necessary frequency spectra would not be available to subsequent sections of the filter.

The analogue signal processor defined in Claim 1 of the present application provides an analogue signal processor having a tone control circuit which is matched to the frequency and intensity properties of a damaged cochlea. This is achieved with the use of log domain filters comprising MOS transistors operating in weak inversion. The arrangement of a pair of log-domain filters and a subtractor provides band-pass filter functionality. There would have been no motivation for a person of ordinary skill in the art to replace the biquad sections of the filter of Toumazou with band-pass filters as set out in Claim 1 of the present application. Such a substitution would have prevented the cascade filter of Toumazou from performing its intended function as already noted. Rather than operating in a cascaded arrangement as illustrated by Toumazou, the audio signal processor as claimed in Claim 1 of the application, which is designed to provide multiple stimulating voltages for a damaged cochlea, makes use of a parallel processing arrangement as illustrated in Figure 2A. As such, Toumazou teaches away from the present invention.

In view of the above arguments, the Examiner's objections with respect to Claims 2-29 are considered moot.

Claim 30:

Claim 1 has been rejected under 35 USC § 103(a) as being unpatentable over Michelson (United States Patent No. 4,400,590) in view of Weisman II (United States Patent No. 6,339,742) Claim 30, as amended, recites a multi-channel analogue audio signal processor for use with a cochlear prosthesis comprising:

"an input for receiving an audio signal;
a plurality of outputs for connection to respective ones of cochlear implant electrodes;
a plurality of analogue signal processing channels coupled to the input, each channel comprising a log-domain filter comprising MOS transistors operating in weak inversion and being coupled to a respective one of the outputs;
a tone generator for generating tones of preset amplitude and frequency dependent on the fundamental frequencies of the filters of the channels; and
adjustment means for adjusting the intensity/frequency response of each channel."

The Office Action states that Michelson discloses a multi-channel analog audio signal processor for use with a cochlear prosthesis (Figure 1), comprising an input for receiving an audio signal (10); a plurality of outputs for connection to respective one of cochlear implant electrodes (16); a plurality of analog signal processing channels couple to the input, each channel comprising a filter coupled to a respective one of the outputs (14); and adjustment means for adjusting the intensity/frequency response of each channel. Michelson does not disclose the use of log-domain filters or MOS transistors operating in weak inversion. The Office Action further states that Toumazou discloses a signal processing circuit (Figure 2) of a log-domain filter employing MOS transistors operating in weak inversion. The Office Action further states that Toumazou teaches the class of filter having a very high dynamic range, good linearity, and high frequency performance. Based on these statements, the Office Action concludes that it would have been obvious to one of ordinary skill in that art at the time the invention was made to combine the use of log-domain filters and MOS transistors with the signal processor to produce a higher dynamic range as taught by Toumazou. For the following reasons, Applicants respectfully disagree.

Claim 30, as amended, incorporates the elements of Claim 33. The Office Action rejected Claim 33 under the same premises, adding that Michelson further discloses a tone generator for generating tones

of preset amplitude and frequency dependent on the fundamental frequencies of the filters (14 and 16) of the channels. Whilst Michelson does describe a multi-channel processor in which the properties of each channel may be adjusted, Michelson does not disclose a tone generator for generating tones of preset amplitude and frequency which are dependent upon the fundamental frequencies of the filters of the channels. In rejecting Claim 33, the Examiner refers to filters-14 and drivers 16. However, these components merely appear to process the amplified input audio signal, the outputs of these components being dependent upon sounds from which the input signal is generated. It cannot be said that these sounds or the input signal generated from them *have pre-set amplitudes and frequencies which are dependent upon the fundamental frequencies of the filters*. Further, Toumazou does not remedy this deficiency as there is no disclosure that would lead a person of ordinary skill in the art to include a tone generator for generating tones of pre-set amplitude and frequency in the signal processing circuitry.

Furthermore, the audio signal processor defined in amended Claim 30 is intended to allow an unskilled user to set the properties of the processor so as to best suit his or her hearing capabilities. It has been found that this process is best facilitated by allowing the user to select pre-set tones one at a time, and to set the intensity/frequency response of the respective channels based upon the hearing sensation which the user perceives. With the processor of Michelson, a specialist audiologist must adjust each channel in turn presumably based upon some general sounds, such as speech and music, etc. It will be appreciated that for each channel, and at any given time, the sounds being played may not be appropriate for that channel. This process is unlikely to achieve an optimum setting for each channel.

In view of the above comments and amendments made to Claim 30, the objections raised by the Examiner against the remaining dependent claims are believed to be moot.

New Claim 40:

New Claim 40 includes the elements of Claim 10 and its base claim and intervening claims. The Office Action indicated that Claims 10-12 would be allowable if rewritten to overcome the rejections under 35 USC §112, second paragraph, set forth in the Office Action and to include all of the limitations of the base claim and intervening claims. Since the Office Action did not include any reference to §112 rejections, Applicants presume that new Claim 40 should be allowable.

Dependent Claims:

Applicants submit that the dependent claims are patentable because they *at least* incorporate the same limitations as their respective independent claims.

Conclusion:

Based on the foregoing remarks and amendments, Applicants believe that all of the claims in this case are now in condition for allowance and an indication to that effect is respectfully requested. Furthermore, if the Examiner believes that additional discussions or information might advance the prosecution of this case, the Examiner should feel free to contact the undersigned at the telephone number indicated below.

Respectfully submitted,

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